Get Your Feet Wet with PSK31

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Get Your Feet Wet with PSK31 Outline of Presentation

- Basics -Sound Card Applications
- Basics - Interface Requirements
- BPSK concept, demo & tour of Digipan
- MFSK concept, demo & tour of MixW
- Build your own interface
- Review of commercial interfaces
- Review of available software

Basics of Sound Card Applications

- Audio frequency in 200 to 5000 Hz range
- Modulation of audio "carrier" using software and sound card
- Transported via SSB radio
- Received by rig and converted back to audio spectrum
- Decode done using software and sound card

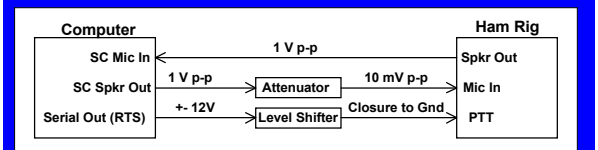
Sound Card Applications - Basics

- Combo of Software, PC, Sound Card, SSB Rig & Interface
- Software
  - Spectrum display to 5 Hz resolution (step size)
  - Bandpass filter for signal - 50 Hz
  - Encode/Decode of signal
  - Graphic User Interface (GUI)
- PC - Windows 95 or later, 100 MHz or faster

Sound Card Applications - Basics

- Rig
  - SSB in either USB or LSB
  - Reasonable frequency stability
  - Tight filters NOT needed in most cases
  - Can NOT use ALC or Compression on Transmit
  - Must stay within TX bandwidth - typically 2200 Hz or less
- Interface
  - Connects the Rig to the PC Soundcard

Sound Card Operating Modes Basic Hardware Interface



Sound Card Modes - Interface Block Diagram

Sound Card Interface Requirements

- Audio from Receiver to PC
  - Signal level 5 Vp-p, typical signal is 1 Vp-p
  - Audio frequency range from 200 to 4000 Hz, or whatever the Rx passband will allow
  - Cables need to be shielded
- Sound Card Accepts 5 Vp-p Before Saturating
  - Software detects and warns against saturated signals at around 1.5 V p-p
  - Ways to control the maximum level to the sound card:
    - RX RF/AF Gain
    - PC Volume Control
    - Interface Level Control

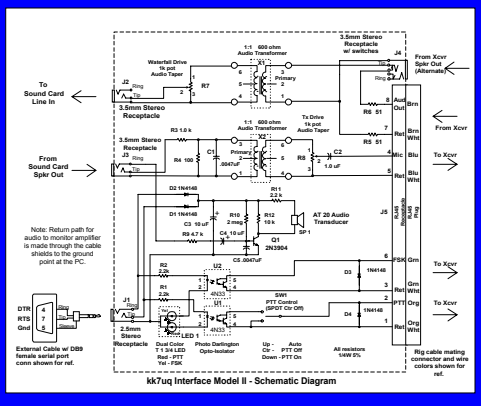
Sound Card Interface Requirements

- Audio from PC to Transmitter
  - Sound Card output up to 5 Vp-p at max level
    - PC slider set at mid level - output is about 1 Vp-p
  - Rig expects microphone levels at about 2-10 millivolt p-p, so signal must be attenuated in the interface
  - Frequency range from 200 to 4000 Hz
    - Max determined by Tx output bandwidth, typically 2200 Hz
  - Audio drive levels determine power output - usually run rig at 25% to 50% of CW rating for clean signal, and cool TX
  - System is operating in an RF environment:
    - Shielded cables - lengths under 6 feet.
    - Good grounding of all components - Rig, PC & Tuner
  - Care taken to mute other audio sources during transmit

Sound Card Interface Requirements

- SSB Rig Control
  - **TX On/Off**
    - Manual Switch - VOX - PTT via Serial Port Control on PC
  - **TX Audio**
    - Input - Mic connector or Accessory Port
  - **TX Audio Drive Level** Set by combination of:
    - Audio level from PC
    - Attenuation level control on Interface
    - Mike Gain on Rig
  - **RX Audio** to PC Provided by
    - Line Out, Speaker/Headset Out, Accessory Port

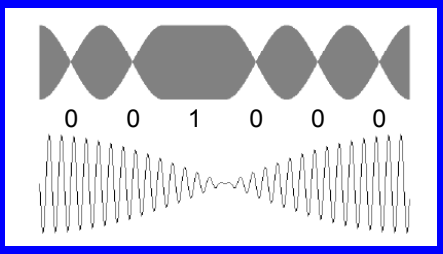
Sound Card Interface


To Sound Card Line In
From Sound Card Spkr Out
3.5mm Stereo Receptacle
From Xcvr Spkr Out (Alternate)
From Xcvr
To Xcvr
AT 20 Audio Transducer
2.5mm Stereo Receptacle
External Cable w/ DB9 female serial port conn shown for ref.
Rig cable mating connector and wire colors shown for ref.
kk7uq Interface Model II - Schematic Diagram

Binary Phase Shift Keying - BPSK31

- Phase modulates an audio "carrier" at 31 baud
- Reverses phase 180 degrees (BPSK)
- Reduces signal level at phase shift time to reduce spurious frequencies
- Uses variable length encoding - most used characters are encoded into small word lengths
- Data rate consistent with that of a fast typist
- Adv: Narrow bandwidth, good performance
- Disadv: Poor performance on long path and over the pole contacts (phase distortion)

BPSK Signal Envelope



Varicode "Space" character = 1
where 0 is a Phase Reversal and 1 is no reversal
must have at least two 0 between characters

BPSK Excerpt of Varicode

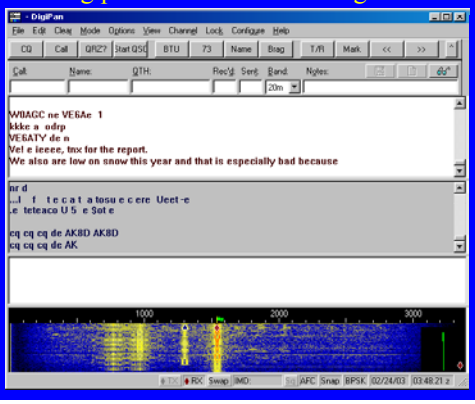
W	101011101	e	11	s	10111
X	101110101	f	111101	t	101
Y	101111011	g	1011011	u	110111
Z	1010101101	h	101011	v	1111011
[	111110111	i	1101	w	1101011
\	111101111	j	111101011	x	11011111
]	111111011	k	10111111	y	1011101
^	1010111111	l	11011	z	111010101
_	101101101	m	111011	{	1010110111
`	1011011111	n	1111	|	110111011
a	1011	o	111	}	1010110101
b	1011111	p	111111	~	1011010111
c	101111	q	110111111	127	1110110101
d	101101	r	10101		

Note that lower case letters have shorter word lengths

SGC 2020-DSP Setup for Sound Card Modes

Digipan Screen with PSK Signals

Digipan Screen with PSK Signals


DigiPan
W0AGC ne VE6Ae 1
VE6ATY de n
We also are low on snow this year and that is especially bad because
cq cq cq de AK8D AK8D
cq cq cq de AK

PSK31 Frequencies

- 3.580 USB
- 7.070 USB
- 10.139 USB
- 14.070 USB
- 18.095 USB
- 21.070 USB
- 24.9195 USB
- 28.120 USB

Live Demo of PSK31 with Digipan

- Transceivers - SGC 2020-DSP
- Interface - kk7uq Model II
- Laptop Computers
- Antenna - Light Bulb

Other Modes - PSK63

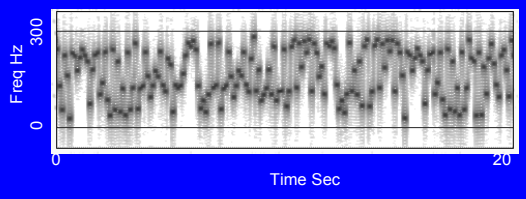
- Designed for contest work
- Faster than RTTY on data rate and exchange - 100 wpm effective rate
- Better S/N than RTTY within 3db of PSK31
- Faster sync recovery than RTTY
- Much lower bandwidth than RTTY
- Full character set
- Look for signals 2.5 kHz higher than PSK31

Other Modes - MFSK16

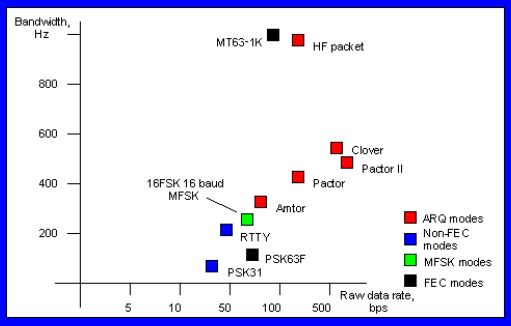
- Multiple Frequency Shift Keying 16 Freqs.
- Four bits per tone
- 250 Hz Wide
- Uses Forward Error Correction (FEC)
- Uses Varicode to optimize throughput
- Data rate consistent with that of a fast typist
- Adv: Very good performance on long path contacts and over polar routes
- Disadv: Wider bandwidth, harder to tune, needs stable TX/RX

MFSK16 Spectrogram

Spectrogram of MFSK16 signal over 20 seconds of transmission. Horizonal lines are at 1000 Hz and 1300 Hz. Contains about 120 characters raw rate, 60 characters effective rate (FEC used).



Comparison of Digital Modes

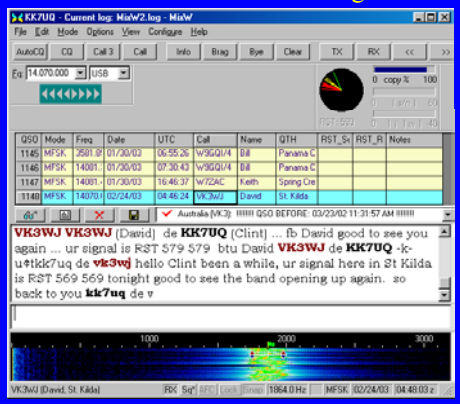


WPM Rates for Various Modes

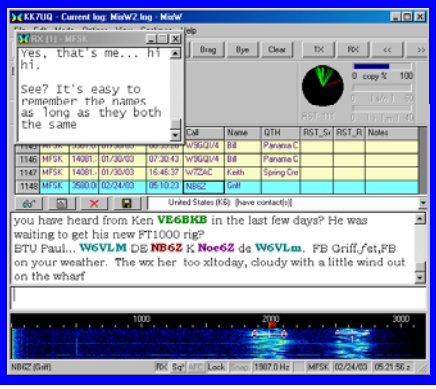
	Time Sec	Char/Sec	WPM	QSO/3KHz
CW 20WPM	324	1.64	19.81	12
Feld Hell	170	3.12	37.76	9
BPSK31	125	4.25	51.36	30
RTTY 45.5Baud	117	4.54	54.87	9
MFSK	110	4.83	58.36	9
BPSK63	62	8.50	102.70	25

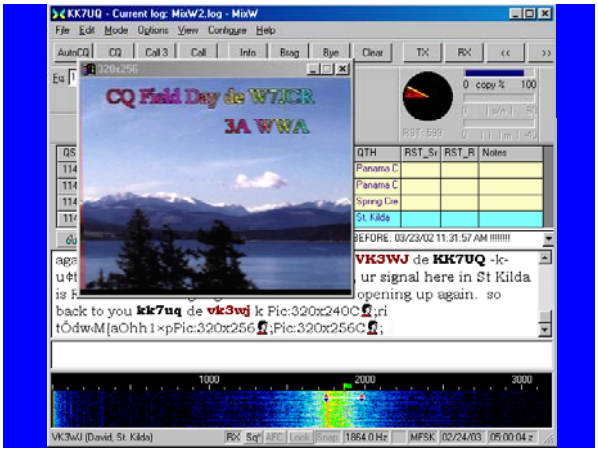
Based on a typical 2 way QSO exchanging English text. 531 characters, 107 words and spaces. I.E. average 6 characters per word.

MixW Screen with MFSK Signals


KK7UQ - Current log: MixW2.log - MixW
VK3WJ VK3WJ (David) de KK7UQ (Clint) ... fb David good to see you again ... ur signal is RST 579 579 btu David VK3WJ de KK7UQ -k-
u*tkk7uq de vk3wj hello Clint been a while, ur signal here in St Kilda is RST 569 569 tonight good to see the band opening up again. so back to you kk7uq de v

MixW Screen with MFSK Signals


Yes, that's me... hi hi.
See? It's easy to remember the names as long as they both the same
you have heard from Ken VE6BKB in the last few days? He was waiting to get his new FT1000 rig?
BTU Paul... W6VLM DE NB6Z K Noe6Z de W6VLm. FB Griff,fet,FB on your weather. The wx her too xltoday, cloudy with a little wind out on the wharf


CQ Field Day de W7ICR
3A WWA
VK3WJ de KK7UQ -k-
ur signal here in St Kilda
opening up again. so
back to you kk7uq de vk3wj k Pic:320x240C;ri
BEFORE: 03/23/02 11:31:57 AM !!!!!!!

Build Your Own Interface
kk7uq Interface Model II

Build Your Own Interface

- Interface Kit $55.00
- Shielded Audio Cables $5.00
- Rig Mic Connector $1.50
- Box of Altoids $2.00
- Total $63.50

Sound Card Interface - Feature Comparisons

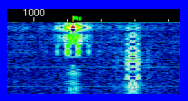
	Mic Switch	Plug in Rig Cable	Fully Isolated	Knob Level Control	Built in Audio Monitor	FSK Control for RTTY	Built In VOX	Approx Cost
Build it Yourself								
BuxComm Rascal kit	No	No	**Yes**	No	No	No	No	$20
kk7uq Model II	No	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	No	$64
Ready to Go w/o Mic. Switching								
BuxComm Rascal MkV	No	**Yes**	**Yes**	No	No	**Yes**	No	$57
MFJ 1273B	No	No	No	No	No	No	No	$70
Rigblaster Nomic	No	**Yes**	No	No	No	No	No	$71
Tigertronics Signalink	No	**Yes**	**Yes**	No	No	No	**Yes**	$67
Ready to Go with Mic. Switching								
MFJ 1275	**Yes**	No	**Yes**	No	No	No	No	$110
MFJ 1279	**Yes**	No	**Yes**	No	No	**Yes**	No	$140
Rigblaster Std	**Yes**	**Yes**	No	No	No	No	No	$121
Rigblaster Plus	**Yes**	**Yes**	No	No	No	No	No	$151
Rigblaster Pro	**Yes**	**Yes**	**Yes**	No	No	**Yes**	No	$311

Sound Card Interface Sources

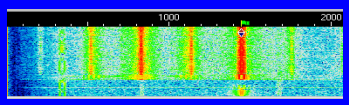
BuxComm	**www.packetradio.com/RASCALplus.htm**
Discovery Bay	**www.waypt.com/users/~discobay/**
MFJ	**www.mfjenterprises.com/**
Tigertronics	**www.tigertronics.com/**
West Mountain	**www.westmountainradio.com/**

Sound Card Modes Software

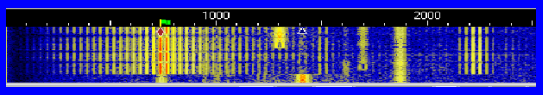
	PSK31 - BPSK	PSK31-QPSK	MFSK-8	MFSK-16	RTTY	CW	Hellschreiber	Name/Screen Pop	Log Supported	
Digipan	X	X						X	Internal	http://www.digipan.net/
Hamscope	X	X		X	X	X			YPLOG	http://www.qsl.net/hamscope/
IZ8BLY	X	X					X		Internal	http://iz8bly.sysonline.it/
MMTTY					X			X	Internal	http://www.qsl.net/mmhamsoft/mmtty/
Stream	X	X	X	X					Internal	http://iz8bly.sysonline.it/
WinPSK										http://www.qsl.net/ae4jy/
WinWarbler										http://www.qsl.net/winwarbler/
Zakanaka	X	X			X			X	Logger	http://www.qsl.net/kc4elo/



PSK mildlly *overdriven* occupies about 100+ Hz

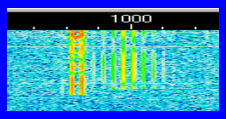


PSK signal at 1450 is ok on drive level but is creating spurs down every 300 Hz probably has *compression* on or bad *RF feedback*



PSK *badly non linear*, occupies 1300 Hz and has harmonic

and there is a third harmonic of the signal



Signal at 1000 is *overdriven* with multiples of 31 Hz on either side of center - about 185 Hz wide

Common Problems & Solutions

- Wide Signal
  - Overdrive of audio on Tx, ALC or Compression on on Tx
- Hum on Signal
  - Needs shielding on cables
  - Common mode noise, use transformers on both channels
  - Ground all system components
- Harmonics of audio carrier
  - ALC on, Compression on
  - Transmitting outside of Tx bandpass
  - Transmitting below 800 Hz audio offset
- Frequency offset between stations
  - RIT is ON, or XIT is ON
  - One of the transmitters has an offset

Common Problems & Solutions

- Signal Cutting In and Out
  - CPU too slow
  - Too many processes running on CPU and active processing
  - VOX is set too close to the signal level
  - Bad connection
- Strange signals mixed with a good psk signal
  - Mute all sources on "Playback" except WAVE
- Sounds from the shack being transmitted, like typing sounds, telephone ringing, etc.
  - Mike is active
  - Mike on PC is active (Mute it - see above)